HANDBOOK OF PHONOLOGICAL DATA
FROM A SAMPLE OF THE WORLD'S LANGUAGES

A Report of the Stanford Phonology Archive

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455 Mandarin

455 01 p[01]
[b][60]

455 02 p-aspirated[01]
[p-aspirated-weak][61]

455 03 t[01]
[d][60]

455 04 t-aspirated[01]
[t-aspirated-weak][61]

455 05 k[01]
[g][60]

455 06 k-aspirated[01]
[k-aspirated-weak][61]

455 08 t/s[01 02 30]
[d/z][60]
(free)

455 09 t/s-aspirated[01 02]
[t/s-aspirated-weak][61]
(free)

455 10 t/s-retroflex[01 03 31]
[d/z-retroflex][60]

455 11 t/s-retroflex-aspirated[01 03 31]
[t/s-retroflex-aspirated-weak][61]

455 12 t/c-fricative[01 04 32]
[d/j-fricative][60]

455 13 t/c-fricative-aspirated[01 04 32]
[t/c-fricative-aspirated-weak][61]

455 14 f

455 15 s[02]

455 16 s-retroflex[03 31]

455 17 z-retroflex[03 31]

455 18 c-fricative[04 32]

455 19 x-uvular
[h][33]
(free)

455 20 m
[m-syllabic][62]

455 22 n[05]
[m-labiodental][63]
(free)

455 Mandarin

23 eng[06 63 64]
(tag(-),allo)
*/yod-trema/

24 l

25 yod-trema[64]
(transitional)
*[eng]
[r-approximant-uvular][64]
(transitional)
[glottal stop][64]
(transitional)

51 i
[i-voiceless][65]
[z-approximant-syllabic][07 66]
[s-approximant-syllabic][07 65 66]
[r-approximant-retroflex-syllabic][66]
[r-approximant-retroflex-voiceless-syllabic][65 66]

52 u-trema
[u-trema-voiceless][65]

53 a-front-retroflexed[35]
(surface)
[epsilon-dot-retroflexed][67]

54 schwa-retroflexed[36 45]
(limited)

55 schwa-nasalized-retroflexed[37]
(surface)

56 a
[ash][08 68]
[a-front][68]
[alpha-unrounded][68]
[epsilon-dot][09 10 68]
[ash-dot][09 10 68]

57 a-retroflexed[38]
(limited)
[ash-dot-retroflexed][69]

58 alpha-unrounded-nasalized-retroflexed[39]
(surface)
[ash-dot-nasalized-retroflexed][69]

59 u[40]
[u-voiceless][65]
[v-syllabic][70]

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[f-syllabic][65 70]
[u/e-dot][40 41 71]
[upsilon][11 43 72]
*/e-trema/

60 u-retroflexed[42]
(surface)

62 e-trema[12]
*[upsilon]
[iota][73]
[e][41 73]
[e-mid][44 73]
(allo,limited)
[schwa][73]
[o][41 73]
[o/e-trema][13 44 73]
(allo,limited)

63 e-trema-retroflexed[14 45]
(surface)
[o/e-trema-retroflexed][74]
(allo,limited)
[e-mid-retroflexed][74]
(allo,limited)

64 yod[15 16]
[j-fricative][46 75]
(allo,limited)

65 w-front[15]
[j-fricative-labialized][75]
(allo,limited)

66 w[17]
[v-approximant][17]
(free)

67 w-retroflexed[42]
(limited)

81 high
[mid][20 47]
(neutral,allo)
[lower-mid][77]
(allo,neutral)
[higher-mid][77]
(allo,neutral)
[low][77]
(allo,neutral)

82 mid-rising[18]

83 lower-mid-falling-rising[19]
[lower-mid-falling][76]

84 high-falling

455 $a Mandarin Chinese $b Peking $d Chinese $e N China $f 400 million $g Marc Okrand$g Marilyn Vihman (review)

455 $a Dow, Francis D. M. $b 1972 $c An Outline of Mandarin Phonetics $f (Oriental Monograph Series, 10) $g Canberra: Australian National University Faculty of Asian Studies

455 $a Chao, Yuen Ren $b 1968 $c A Grammar of Spoken Chinese $g Berkeley: U. C. Press $q author is native speaker $r over 50 years

455 $a Cheng, Chin-Chuan $b 1973 $c A Synchronic Phonology of Mandarin Chinese $f (Monographs on Linguistic Analysis, 4) $g The Hague: Mouton

455 $a Karlgren, Bernhard $b 1915-1926 $c Etudes sur la phonologie Chinoise $f (Archives D'Etudes Orientales, 15) $g Leyden: E-J Brill

455 $a **INTONATION** $A A "list and brief description of some of the most important varieties of Chinese intonation" appear in Chao, p.39-44. Rising and falling pitches are treated as particles in Chao, p.812-814.

455 $a **MARGINAL SPEECH SOUNDS** $A Interjections may contain sounds otherwise absent from Mandarin phonetics (e.g. ingressive airstream, [i-voiceless-labialized], [h-voice]). A list occurs in Chao, p.815-819.

455 $a **MORPHOPHONEMICS** $A Tone sandhi and weak stress occasionally are used morphologically. The morpheme /i/ "one" takes weak stress when inserted on a reduplicated verb. (p.106) An adverb formed by reduplication of an adjective plus suffix /schwa-retroflexed/ takes /high/ tone on the second syllable. (p.94, 105) Weak stress occurs on: (1) object pronouns following verbs (generally); (2) complements to verbs or adjectives; (3) location complements to nouns (often); (4) second syllables of reduplicated nouns or verbs in certain constructions. (p.114-120)

455 $a **STRESS** $A Except for syllables with weak stress, which is lexically or grammatically determined, or contrastive stress, each syllable receives "a slight, even stress." (p.122) In sequences of syllables "without intermediate pause" (Chao, p.35), the last syllable is most stressed, the first is next, and medial syllables, if any, are least stressed. $A Weak stress "occurs in suffixes, particles, pronouns as objects (except when in contrastive stress), and verbs reduplicated as cognate objects." (Chao, p.38) Other occurrences of weak stress must be indicated lexically. There are some cases of free variation between weak and normal stress. $A "Stress in Chinese is primarily an enlargement in pitch range and time duration and only secondarily in loudness." (Chao, p.35) $A Contrastive, or emphatic, stress "has a wider pitch range and longer duration, usually with associated loudness." (Chao, p.35) $A In weak stress, the lexical tones are neutralized, and the duration of the syllable is relatively short. Most cases of weak stress closely follow a normal stressed syllable. Weak stress is also termed "neutral tone" (Chao) or "atonic" (Dow). Weakly stressed syllables are considered "unstressed".

455 $a **SYLLABLE** $A (C)(G)V(C) $A final C: /yod, w, n, eng/

455 $a **TONE** $A domain of tone: syllable $A "Every [normally] stressed syllable has a tone, spread...over the voiced part of the syllable". (p.25) There are a few inherently weakly stressed (monosyllabic) morphemes (e.g. suffixes, particles) which, thus, lack a lexical tone.

455 01 $A The plain obstruents are "pronounced with weaker articulation [than the aspirates] without aspiration and voicing; ...[they are] lenis. In addition to the presence or absence of aspiration, the different strength of articulation is a distinctive feature;" the aspirates are "made with a strong tension of the muscles and a vigorous aspiration...; [they are] fortis...." (p.25f, 33)

455 02 $A In the production of /t/s, /t/s-aspirated/, and /s/, "the position of the tongue tip varies from speaker to speaker." (p.30f) For some, these segments may be apico-alveolar. /s/ may be blade-alveolar.

455 03 $A The retroflex sounds of Chinese are "pronounced without lip-rounding except when...followed by a vowel requiring rounding." (p.43) Cf. also p.39.

455 04 $A "The lip position of the [palatal obstruents] followed by /-i/ is free" (p.47f) (i.e., not rounded as in the production of the English palatoalveolar affricates and fricatives).

455 05 $A /n/ "is more weakly articulated when occurring after [a-front] than after other vowels. That is, it is articulated with the tongue not quite reaching the alveolar ridge." (p.35)

455 06 $A /eng/ "may be produced from a number of slightly different points of dorso-velar contact depending upon the sound with which it is combined. Usually it is produced towards the front with the front vowels, towards the back with the back vowels." (p.52)

455 07 $A In articulating the syllabic sibilants, "the highest point of the tongue is slightly more front and the back of the tongue is slightly higher [than for [i]].... [There are] two simultaneous points of articulation, one at the tongue tip and the other at the body of the tongue." (Cheng, p.13) The syllabic sibilants are "pronounced by keeping the tongue tip almost exactly in the position it is in for the preceding dental sibilants. In other words, ...widen the passage between the tongue tip and the gums just enough to stop the friction." (p.77) Karlgren (p.294ff) distinguishes "apical" vowels, characterized by the position of the apex, from "dorsal" vowels, characterized by the position of the dorsum.

455 08 $A For some speakers [ash] can be higher between /yod/ and /n/. (p.79)

455 09 $A [epsilon-dot] is described as "a more open variety of [schwa]," [ash-dot] is "a more open variety of [epsilon-dot]" (p.65); both are "indistinct" (p.65) or "obscure" central vowels. (p.111)

455 10 $A Under weak stress, the vocalic part of the syllable is "weakened and obscure" but the centralization may be optional: [ash] and [a-front] "tend to be reduced to obscure, central vowels." (p.111)

455 11 $A Between /w-front/ and /eng/, the "middle obscure element...has a slight [u] quality." (p.83) Chao (p.23) calls the vowel [upsilon].

455 12 $A With regard to the quality of /e-trema/, Chao remarks, "Actually the vowel is more consistently a central-back vowel." (Chao, p.23) "This vowel is located between [schwa] and [e-trema]." (p.75) Before /yod/, the vowel is described as less "open" than [e] (p.68); between /w-front/ and /n/ "it has a slight [i] quality." (p.83) (= [iota] in the Archive)

455 13 $A Dow describes the combination /w/ plus [o/e-trema] as "produced by rounding the lips for a non-syllabic [upsilon] and immediately moving to a syllabic [e-trema] (p.70); after labial initials, /w/ is lost, but the remaining vocalic sequence is "identical" to /w/ plus [o/e-trema] (p.71), or is [e-trema] "pronounced with slightly rounded lips." (p.28) [o/e-trema] is transcribed by Chao as [o/caret-glide]. (p.23, 54)

455 14 $A /e-trema-retroflexed/ is a "longer" vowel than /schwa-retroflexed/. (Chao, p.51f)

455 15 $A Dow transcribes the glides as lower-high [iota], [upsilon-trema], and [upsilon] to indicate that the high position is not always reached. Other writers transcribe [i] or [yod], [u-trema] or [w-front], and [u] or [w]. Dow uses "lax" higher-mid vowel symbols for the glides because they are "generally produced with lesser muscular tension in the speech organs, weaker breath pressure, and correspondingly lesser concentration of energy in the spectrum and in time." (p.64)

455 16 $A Between alveolar consonants and /a/, /yod/ may be higher-mid. (p.60)

455 17 $A According to Dow (p.57) /w/ is "pronounced with friction" syllable initially and after velar and uvular consonants. Also, a minority of speakers use [v-approximant] syllable initially before /a/. /w/ before syllable-final /e-trema/ causes a rounding of the onset of the vowel, and except when initial or after a velar or uvular consonant, is apparently quite weak as an independent segment. (Cf. p.71.)

455 18 $A On the basis of spectrographic evidence Dow (p.103-4) considers the /mid-rising/ tone to begin with a slight dip (from lower-high to mid pitch). Chao (p.55) remarks that under contrastive stress "there is, at least with some speakers, a glottal stricture and even a dip" in the /mid-rising/ tone.

455 19 $A Chao remarks that the "dip" of the /lower-mid-falling-rising/ tone contains a "glottal stricture." (p.55)

455 20 $A Unstressed syllables are tonally neutral. Pitch level is typically [mid] but varies according to environment. "The tone range is flattened practically to zero," (p.35) and "the duration is relatively short."

455 30 $A For many speakers, noun-suffix /t/s.i/ is weakened to [z.schwa], with voiced fricative initial. (Chao, p.36)

455 31 $A The retroflex sibilants tend to merge as /z-retroflex/ in weakly stressed syllables, according to Chao (p.37), who uses "r" as the symbol for the voiced counterpart of /s-retroflex/. (p.22)

455 32 $A In rapid speech, the palatal obstruents tend to be lost in weakly stressed syllables. (Chao, p.37)

455 33 $A "Mandarin-speaking children...tend to use [h] in place of...[x-uvular]." (p.54)

455 35 $A /a-front-retroflexed/ arises as a fusion of /a.yod/ or /a.n/ plus suffix /schwa-retroflexed/.

455 36 $A As an independent syllable, /schwa-retroflexed/ occurs only in /mid-rising/ tone. Under weak stress, it contrasts with /a-retroflexed/. It also arises from fusion of suffix /schwa-retroflexed/ with preceding /i/ or with any preceding non-low vowel plus /yod/ or /n/; any high vowel is lost or becomes a glide. According to Chao (p.51) /schwa-retroflexed/ also occurs as a fusion of /e-trema/ and suffix /schwa-retroflexed/ after /yod/ or /w-front/ in /lower-mid-falling-rising/ or /high-falling/ tones (cf. /e-mid-retroflexed/).

455 37 $A /schwa-nasalized-retroflexed/ arises as a fusion of /e-trema.eng/ plus suffix /schwa-retroflexed/; also /i.eng/ plus suffix /schwa-retroflexed/ becomes

/yod.schwa-nasalized-retroflexed/.

455 38 $A As an independent syllable, /a-retroflexed/ occurs only in /lower-mid-falling-rising/ and /high-falling/ tones. It also arises from the fusion of /a/ and suffix /schwa-retroflexed/ (any tone).

455 39 $A /alpha-unrounded-nasalized-retroflexed/ arises as a fusion of /a.eng/ plus suffix /schwa-retroflexed/.

455 40 $A In Chao's analysis, there is no final sequence [u.n]; it and [u/e-dot.n] are both considered [w.schwa.n].

455 41 $A For most, but not all, speakers, when a word in /lower-mid-falling-rising/ tone shifts to /mid-rising/ tone as a result of tone sandhi, the vowel quality remains unchanged. (Chao, p.54). Thus, [u/e-dot] would not become [u] and [e] would not be raised to [iota] nor [o] to [upsilon].

455 42 $A /u-retroflexed/ and /w-retroflexed/ arise from a fusion of /u/ or /w/ plus suffix /schwa-retroflexed/.

455 43 $A Dow considers [upsilon] to be a realization of the phonemic sequence /w.e-trema/ in certain environments, and of /e-trema/ alone in others. (p.72, 81-3) Dow's /w.e-trema/ is here reanalyzed as a unit phone /u/.

455 44 $A In interjections and particles [o/e-trema] occurs syllable-initially and contrasts with [e-mid]. (Chao, p.53-54)

455 45 $A According to Chao (p.51), /e-trema-retroflexed/ is limited to speakers of the "older generation;" the "new generation" uses /schwa-retroflexed/. The former arises as a fusion of /e-trema/ and suffix /schwa-retroflexed/. According to Chao, the allophone [e-mid-retroflexed] occurs only in /high/ and /mid-rising/ tones; in other tones [schwa-retroflexed] occurs.

455 46 $A [j-fricative] and [j-fricative-labialized] may occur as onset to syllables beginning with /i/ and /u-trema/, respectively.

455 47 $A Under weak stress, all tones neutralize; the pitch is determined by the preceding stressed syllable. (See note 77.)

455 60 $A Unaspirated stops and affricates become voiced in syllables under weak stress. (p.111) (The rule is optional in the case of /t/s/.)

455 61 $A Aspirated stops and affricates become weakly aspirated in syllables under weak stress. (p.111)

455 62 $A At conversational speed, certain morphemes with initial /m/ are reduced to /m-syllabic/ under weak stress. (p.110)

455 63 $A Syllable-final /n/ frequently assimilates in place of articulation to a following bilabial or velar stop or labiodental fricative. (p.35)

455 64 $A A velar or uvular sonorant or [glottal stop] may be inserted before syllable-initial non-high vowels. (p.56) A small minority of speakers insert [eng] before syllables with initial vowels /a/ or /e-trema/.

455 65 $A High vowels tend to be voiceless following voiceless fricatives (except /x-uvular/) or aspirated affricates, when in open syllables under weak stress following a syllable in /high-falling/ tone. (p.111) (Dow comments that they "tend to be whispered, devoiced, or completely deleted.")

455 66 $A /i/ becomes [z-approximant-syllabic] following dental affricates or fricatives, and [r-approximant-retroflex-syllabic] following retroflex affricates and fricatives. (p.77f)

455 67 $A /a-front-retroflexed/ is realized as [epsilon-dot-retroflexed] under weak stress.

455 68 $A /a/ is realized as [ash] before final /yod/ and between medial /yod/ and final /n/, as [a-front] before final /n/ when not preceded by /yod/, as [alpha-unrounded] before /eng, w, w-retroflexed/, as [epsilon-dot] before /yod/ or /n/ under weak stress, and as [ash-dot] syllable finally or before /eng, w, w-retroflexed/ under weak stress. (p.67f, 75, 79, 86)

455 69 $A /a-retroflexed/ and /alpha-unrounded-nasalized-retroflexed/ are realized as [ash-dot-retroflexed] and [ash-dot-nasalized-retroflexed] under weak stress.

455 70 $A /u/ is realized as [v-syllabic] after /f/. (p.28) (Chao makes no mention of this phone.)

455 71 $A /u/ is realized as [u/e-dot] before /n/ in /lower-mid-falling-rising/ and /high-falling/ tones.

455 72 $A /u/ becomes [upsilon] before /eng/. /e-trema/ becomes [upsilon] between /yod/ and /w/ or /w-retroflexed/ in /high/ and /mid-rising/ tones, and also between /w-front/ and /eng/. (p.81ff

455 73 $A /e-trema/ is realized as [iota] between /w/ and /yod/ in /high/ and /mid-rising/ tones, and also between /w-front/ and /n/ (any tone); it is realized as [e] before /yod/ when there is no preceding glide, and between /w/ and /yod/ in /lower-mid-falling-rising/ and /high-falling/ tones; it is realized as [e-mid] after /yod/ or /w-front/ in open syllables; it is realized as [schwa] when no glide precedes and /n/ or /eng/ follows. Following /w/, [schwa] occurs before /n/, and before /eng/. Under weak stress, [schwa] also occurs before /yod/, /w/, /w-retroflexed/ and in open syllables with no preceding glide. Whatever vowel occurs between /w-front/ and /n/ under weak stress is not exemplified. Commonly before suffix for interrogatives and adverbs [m.schwa], [schwa] occurs as if in a closed syllable; rarely, [e-trema] occurs as if in an open syllable. (Chao, p.53) /e-trema/ is realized as [o] before /w/ or /w-retroflexed/ when there is no preceding glide, and between /yod/ and /w/ or /w-retroflexed/ in /lower-mid-falling-rising/ or /high-falling/ tones. /e-trema/ is realized as [o/e-trema] after /w/ in open syllables.

455 74 $A /e-trema-retroflexed/ is realized as [o/e-trema-retroflexed] after /w/ and as [e-mid-retroflexed] after /yod/ or /w-front/.

455 75 $A /yod/ and /w-front/ are produced with "friction" (p.57) or "slight friction" (p.60) syllable-initially and following palatal consonants.

455 76 $A The /lower-mid-falling-rising/ tone is realized as [lower-mid-falling] before any tone other than /lower-mid-falling-rising/. (It also occurs before a syllable under weak stress (where tones are neutralized). If, however, the weakly stressed syllable is one that would be in /lower-mid-falling-rising/ tone if normally stressed, the [lower-mid-falling] tone apparently occurs only if the two syllables are in the same "word." If the two syllables are in different words (in a phrase, or in a reduplicated verb) the exact contour of the /lower-mid-falling-rising/ tone (in the first syllable) is subject to dispute. Chao (p.55-6) considers it a falling-rising tone with pitch heights [mid.lower-mid.high]. Cheng (p.43-6) considers it to be the /mid-rising/ tone, which occurs as the realization of a /lower-mid-falling-rising/ tone before a syllable also in /lower-mid-falling-rising/ tone.)

455 77 $A The /mid/ (neutral) tone is realized as [higher-mid] following syllables in /lower-mid-falling-rising/ tone, as [low] following syllables in /high-falling/ tone, and as [lower-mid] following /high/ tone. [mid] pitch follows syllables in /high-rising/ tone; it also occurs in the relatively few cases where no stressed syllable precedes a weakly stressed syllable. (Chao, p.36) Dow (p.113) says that the neutral tone is [low] after both /high/ and /high-falling/.